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IV. *A Letter from Granville Wheler, Esq; to Dr. Mortimer, Secr. R. S. containing some Remarks on the late Stephen Gray, F. R. S. his Electrical Circular Experiment.* *

S I R,

SOME odd Circumstances led me to make Mr. Gray's circular Experiment in the following Manner. While I excited a Cake of Rosin and Beeswax ten Inches Diameter, by clapping with my Hand, I let my ivory Ball continue in a Basin of Water; then shaking off the Drops, placed it in the Centre, and with my right Hand held a fine Thread, about eight or nine Inches long, having one End rolled up into a little Ball, and the other, for about an Inch, reduced to its greatest Fineness, to only one Fibre, myself and Hand being supported on the Back of a Chair. The Success was, I had a great many Revolutions, to the Number of Fifty, from West to East; but at first not so regular as towards the last, at first describing only about one third Part of the Circumference at a time, and after standing still a little, describing another third Part. I might probably have had a great many more Revolutions, but being tired, I was forced to rest myself, which I did for ten Minutes, then took up the Thread again. The Thread stood repelled at some Distance, without making any Revolutions, and at last only made half an one the contrary way to what it did before; but upon wetting it, by drawing it two or three times

* See *Philosophical Transactions*, n. 441, p. 220. and n. 444, p. 400. of the Revolutions of *pendulous Bodies* by Electricity.

over the Surface of the Water, it made again twenty more Revolutions from West to East, only at a smaller Distance from the Ball, (for the Water must make it heavier) but full as regular as before, and rather quicker: The Virtue of the Cake must now have lasted about three quarters of an Hour. After resting about six Minutes, I tried again with the String fresh wetted, the Ball and Cake continuing as before; and had, to my great Surprise, one hundred Revolutions in the Space of about twelve Minutes, the Revolutions being still quicker, and more regular, and nearer the Ball; and at the sixth Revolution of this last Hundred, the Thread was attracted to the Surface of the Ball, and, being wet, did not disengage itself, till pulled away; yet after this, described the remaining Ninety-four Revolutions of the Hundred, and seemed inclined to describe a great many more, but that I was forced to rest my Arm again, which I did for about eight Minutes, then tried again, the Thread being fresh wetted, and had seventy Revolutions at nearly the same Distance from the Ball in less than nine Minutes, all very regular, and without any Attraction of the Thread to the Ball. I rested again sixteen Minutes, wet the Thread again, and held it as usual; it was repelled at about half an Inch Distance from the Ball, but seemed to have no Tendency to a circular Motion; yet after continuing stationary about a Minute, I perceived a Motion about its Axis, about which it took several Turns; but still had little or no progressive Motion, till about a Minute longer, when it began to move forward, and continued doing so from West to East, for about thirty-three Revolutions, very regular, but slower than in the two last Cases, the String having been held about ten Minutes,

minutes, and the Revolutions performed in about seven or eight of them. I observed each of these three last times, it was rather longer before the progressive Motion began than usual; and in all the Trials of this Experiment, I frequently perceived a Motion about the Axis, which was generally from West to East, though now-and-then the contrary Way. The Virtue of the Cake must now have lasted near two Hours; about three quarters of an Hour after, I tried again, and had sixty Revolutions from West to East, in about ten Minutes, the Distance from the Ball being still less than before, hardly one quarter of an Inch, scarce any Revolution about the Axis appeared, and at the Beginning the Thread was twice attracted to the Ball. About an Hour and half after, the Virtue of the Ball was not quite gone, the wet Thread being repelled, and making three or four Revolutions from West to East, as well as moving a little about its Axis the same Way. But as it was reasonable to suppose the Ball itself in the Centre of the Cake was now dry, with a Feather dipp'd in Water I wet its Surface; yet found no Increase of Virtue, rather a Diminution of it, the pendulous Body seeming scarce at all repelled; but it is to be observed, that the Ball, as it was wetting, twice tumbled over, and rolled upon the Surface of the Cake; by which means the Virtue of the Cake might be much diminished.

It is not improper too to take Notice here, that during the Revolutions of the wet String, I have frequently observed a kind of Oscillatory Motion, as if there was an alternate Intention and Remission of the repulsive Force. As also that I have often took Notice of little Plucks, and convulsive Motions,
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in the pendulous Body, and sometimes thought I have felt something like it in my Arm that held it, though at no other time have I ever been sensible of any such thing.

I have several times since repeated this Experiment with the Thread and Ball both wet, and found it succeed much better than when they were both dry ; and once I find by my Notes I had two hundred and twenty Revolutions before I rested my Arm. I have tried too with the Ball dry, and the String only made wet ; but the Virtue did not continue so long, as when both were wet.

I now flattered myself with Hopes of Success, if the Thread was suspended from an undoubted fixed Point, which therefore I proceeded again to try with the greatest Care and Caution, but in vain ; the Revolutions were uncertain.

This Difference naturally led me to reflect upon the Cause of it. The Tremor of the Hand would not account for it ; for this being both ways backward as well as forward, must as often hinder as promote a continual Motion one way : And though in two opposite Parts of a Circle, the Motion is really in contrary Directions, and therefore the contrary Impulses of a Tremor may promote a Revolution applied at opposite Places of the Orbit ; yet as these Tremors are irregular, and succeed much quicker than the Revolutions are perform'd, they seem insufficient to account for the Motions of the pendulous Body, performed with any Degree of Regularity.

A Stream of Air in my Room might impel along the Tangent the pendulous Body, kept at a Distance from the Ball by its repulsive Force ; and then Gravity,

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taking place, might with the first Motion compound a Curve; but still the Resistance of the Air would soon destroy the original Impulse, could a few Revolutions be performed; and besides, one Revolution could not be performed, because the same Stream of Air that began the Motion, must be contrary to it in its Return.

A Finger held on the right Hand near the pendulous Body, when suspended from a fixed Point, will make it revolve from West to East; but then it must be applied and removed alternately: The repulsive Force therefore which the Arm may acquire, by being held in the Sphere of the *Effluvia*, is insufficient; for, as it is in one Place, it must impel only one way, and constantly the same way; and therefore, like a Stream of Air in the Room, though it might create the Beginning, it must hinder the Completion of a Revolution.

Sometimes I have doubted, whether the Pulse of the Arm might not be assisting in giving a projectile Motion. When one Leg is laid over the Knee of the other, a Motion and Heaving of the Leg that lies over, answering to every Stroke of the Pulse, is very apparent at a Distance: The Arm therefore in some Postures, in which its great Artery meets with a proportionable Pressure or Resistance, may have a constant Motion, though less perceivable.

What seemed the most probable Solution, was this: When the Arm is extended, the Posture being uneasy, there must be a Reaction of the Muscles, or a continual pulling of the Arm towards the Body. When therefore the right Arm is made use of, the pulling will be from Right to Left; and consequently
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the Motion produced in the Body held by it in the same Direction, or from West to East. When the left Arm is made use of, the Reaction of the Muscles will be from Left to Right, and therefore the Motion of the pendulous Body from East to West. And, agreeably to this, I have observed, (as I formerly took Notice, though this Reason did not then occur to me) when I used my left Hand, all other Circumstances continuing the same, the Motion of the pendulous Body was from Left to Right, or from East to West, contrary to what was observed when held by the right Hand.

Yet still neither of these Solutions would account for the Variety of Oddnesses I have met with under various Circumstances.

I proceeded therefore to try with Rests for my Arm of different Heights, having an Arm of Wood, about two Feet long, fixed to a Rest for my Telescopes, which I could raise to any Height I wanted; and I found the Experiment succeed only well, when the Rest was lower than the electric *Area*, and the Arm was supported upon its Elbow, which was the Posture constantly made use of, when rested upon a Chair, the Chair being lower than the electric *Area*, that it might less affect the *Effluvia*, as was then thought.

I began now to think with myself, whether it was not possible, that an Inclination to a Motion one way in the Person that holds the Body, might not have such an Influence upon the Arm, and consequently the String and pendulous Body, as to determine them the same way by some Pressure or Byass put upon it, though no Motion sensible even to him-

self, was produced in the Hand. If so, I might, by a contrary Inclination, produce a Motion the contrary way. Having therefore a fine Day, and my circular Cake being well excited, I tried if I could not produce a regular Motion from East to West, about the Ball in the Centre, having my Hand supported, as usual, upon the Back of a Chair. I found I could produce a very regular one from East to West for many Revolutions, and change from one Motion to another, without being sensible I moved my Hand at all.

I then wet the Ball and String, as in the Experiment before-mentioned, and found I could tire myself with a Motion either from East to West, or from West to East, as I pleased, without giving any Motion, that I could perceive, to my Hand or Fingers. Hence many odd Experiments that please, may, when repeated, succeed.

Since therefore the Motion of the pendulous Body from a Point undoubtedly fixed, is irregular, as I have found by many different Experiments, repeated with the greatest Care and Caution; and since I am convinced from these last-mentioned Trials, the Motion from West to East, and from East to West, must generally have been determined by myself; I am inclined to think, that a Desire of producing a Motion from West to East, was the secret Cause that determined the pendulous Body to that Direction, by some Impression from Mr. *Gray's* Hand, as well as my own, though I am persuaded at the same time, he was not sensible of giving any Motion to his Hand himself: And I the rather think this was the Case, from the Instance Mr. *Gray* gives, by way of Explanation,

nation, of a Man resting his Elbows upon his Knees, this implying that he rested his Arm upon his Elbow, as I did myself.

But though upon the Whole it does at last appear, that this Motion from West to East in a pendulous Body, applied to another in the Centre of an electric *Area*, is to be ascribed to the Hand that holds it, and not solely to the Nature of the electric *Effluvia*, or the Figure of the central Body; yet still, perhaps, it may not be improper for Astronomers to consider, whether or no a Medium with this Property, that all Bodies immersed in it, are repulsive of one another, ought not to be joined with Gravity to explain the heavenly *Phænomena*; especially since the *Phænomena* of Fire, and our electric *Effluvia*, have a great Affinity to each other; and since many of the heavenly *Phænomena* are to be accounted for, upon this Supposition, with great Simplicity; and some of them, that have not yet perhaps been fully accounted for, seem necessarily to follow.

I am, Sir, with a very great Regard,

Otterden-Place,
Feb. 20. 1737-8.

*Your much obliged,
humble Servant,*

Granv. Wheeler.

P S. This was intended to have been sent eleven Days ago.

Mar. 3. 1737-8.